

## A Study of the Regional Resource Curse: The Evolving Impact of Oil and Gas Economics on Caddo Parish, Louisiana

**Perry Wisinger, PhD**

Assistant Professor

Department of Accounting and Finance

College of Business and Economics

Regis University

Denver, CO 80211

Phone: (303) 458-4934

Mail: [pwisinger@regis.edu](mailto:pwisinger@regis.edu)

USA

**Charlie Penrod, JD**

Assistant Professor

University of West Florida

Pensacola, FL 32514

Mail: [cpenrod@uwf.edu](mailto:cpenrod@uwf.edu)

USA

**MarkSwanstrom, PhD**

Associate Professor

Northwestern State University

Natchitoches, LA 71497

Mail: [swanstromm@nsula.edu](mailto:swanstromm@nsula.edu)

USA

### Abstract:

*This article investigates the reasons why Shreveport is the fastest shrinking municipal economy in the U.S. by studying the evolving dependency of the local economy on the oil and gas industry from 1980 to 2012. Sources and causes of changes to Caddo Parish retail sales during this period were identified from time lapse models using ordinary least squares regression analysis. Regression data were obtained from the Caddo-Shreveport Sales and Use Tax Commission, U.S. Bureau of Labor Statistics, U.S. Energy Information Administration, International Monetary Fund, and Film Shreveport Bossier. Model results indicate the instability in Caddo Parish retail sales caused by the collapse of oil and gas prices during the 1980s has evolved. As of 2012, the major sources of retail sales volatility appear no longer to directly relate to changes in wellhead oil and natural gas prices, but rather on the current natural gas glut, the related pace of Haynesville/Bossier shale gas development, and location filming for Hollywood movies and TV.*

### Highlights:

1. Uses regression analysis to time-lapse model county retail sales from 1980 to 2012
2. Models the evolving impact of changing oil and gas prices on Caddo Parish
3. Measures the impact of Shreveport Bossier City riverboat casinos on retail sales
4. Measures the impact of Hollywood filming on location on retail sales
5. Measures the impact of Haynesville Shale natural gas on retail sales

### JEL Classification Codes:

C230 Single Equation Models; Single Variables; Models with Panel Data

Q410 Energy: Demand and Supply

Q470 Energy: Forecasting

R11 Regional Economic Activity: Growth, Development, and Changes

R150 General Regional Economics: Econometric and Input Output Models; Other Models

**Keywords:** Haynesville Shale; Caddo Parish, Louisiana; Hollywood; Retail Sales; Oil Prices; Natural Gas Prices; Regression Analysis; Casino; General Motors; Western Electric; Economic Impact; Film Production; Time-lapse Modeling

### Introduction:

One day, no matter how seemingly inexhaustible, the oil and gas will run out. The horse head pumps will stop rocking, the pipeline will empty and the drill rigs will move on in search of new deposits. In preparation for that day, businesses, policymakers, and other stakeholders need to understand how much their economy depends on dwindling oil and gas reserves. Although new technologies might allow for even greater oil and gas yields, policymakers would be wise to know how much of an impact the ebbs and flows of oil and gas revenues have for both short-term and long term financial planning.

Older than the legendary Spindle top Hill in southeastern Texas, the rich oil and gas fields of northwest Louisiana and the surrounding Piney Woods date back over 100 hundred years (BCM Energy Partners, Inc. 2012). Louisiana's first document use of natural gas was lighting the Shreveport Ice Factory from gas discovered while drilling for water in 1870. Legend tells of a Caddo well that in May 1905 produced gas pressure that could be heard 10 to 15 miles away and caused a crater that "swallowed the 70-foot derrick, a steam engine, two Gardner pumps, and 3500 feet of drilling pipeline." By 1910 Caddo Parish produced 75% of all oil in Louisiana (Pels 2004). The J. M. Guffey Petroleum Company, later known as Gulf Oil, drilled the world's first over-water oil well in Caddo Lake, completing the Ferry Lake No.1 in 1911 (Offshore Oil Drilling on Caddo Lake 2013). Second only to Gulf Oil, United Gas of Shreveport led the southeastern states in oil exploration during the 1930s and this company, originally known as Palmer Corporation of Shreveport, operated gas wells with a short pipeline to the northwest Louisiana City of Shreveport before 1915 (Hughes 1993). Near the heart of Shreveport, the current Shreveport State Office Building was built and occupied by United Gas for years before the company transferred its headquarters to Houston.

Covering 879 square miles, the estimated population of Caddo Parish stayed basically flat from 252,000 in 1980 to 257,000 by 2012. While 22 percent of Caddo Parish held at least a bachelor's degree in 2011, parish median household income was \$39,000 with 20 percent living below poverty level (U.S. Census Bureau 2013a). As of 2012, there were an estimated 202,000 people living in Shreveport, the parish seat (U.S. Census Bureau 2013b). Shreveport has the distinction of being the largest city and capital of a socio economic region unofficially known as the Ark-La-Tex, a region where Arkansas, Louisiana, Texas and Oklahoma nearly intersect. During World War II, as part of the war effort, the federal government laid two pipelines from east Texas to the northeast states for transporting crude oil and refined products; following the war, a new corporation, Texas Eastern Transmission Corporation paid \$143 million to purchase both pipelines for transporting natural gas (Palmer and Johnson 2013) and established its original corporate headquarters in the regional capital of Shreveport. On 20 February 1989, Texas Eastern, having moved its headquarters to Houston during the 1970s, accepted a friendly takeover bid of a hefty \$3.2 billion from the smaller Panhandle Eastern Corporation (Hayes 1989). The 14 story Texas Eastern Building, now named the Center Point Energy Building, in downtown Shreveport and the former United Gas Building stand as visible reminders of the global role the area once played in oil & gas leadership. Unfortunately for Caddo Parish residents, by 1980 both had moved their administrative offices to the emerging oil & gas capital Houston leaving behind only mature oil & gas fields, an oversupply of oil field workers and an socio economic legacy of broken promise.

*For the second consecutive year, the Shreveport area shrank more than any other metro area in the nation. 24/7 Wall Street, 31 January 2014*

But why? This economic proclamation should be unlikely because it follows the 2008 major discovery of regional shale natural gas. By studying the Shreveport metro area, perhaps a better understanding of causes,

warnings and mitigations surrounding local economic instabilities can be gained. To avoid problems of changing municipal geographies, this study focuses on the parish surrounding Shreveport, i.e. Caddo Parish.

After adjusting for inflation, oil prices plunged 63% between 1981 and 1988 with devastating results for a Caddo Parish economy dependent on wellhead oil prices (Wisinger 1989). Local banks merged into national banks and downtown office space vacancies skyrocketed as businesses failed and unemployment grew. An unpublished paper, *The Economic Impact of Changing Crude Oil Prices on Caddo Parish Retail Sales*, noted, after adjusting for seasonal effects and inflation, that changes in the price of crude correlated with 76 percent of the fluctuations in Caddo Parish retail sales for the seven-year period ended 31 December 1987; during that same period each dollar decrease in the price of a barrel of Louisiana crude oil seemingly decreased Caddo Parish monthly retail sales by \$1.3 million when 1987 average monthly sales were \$56.5 million in 1988 dollars (Wisinger 1989). While that 1989 paper limited its investigation to just the impact of changing crude oil prices, the current study proposes to expand the number of possible causation variables to include natural gas prices, significant events and major changes to basic industries. Business leaders, political leaders and the residents all need to know: Has the composition of the Caddo Parish economy changed over time since 1980, or is it still extremely vulnerable to downturns in the oil industry? What are the reasons for the current economic decline? The methodology and lessons learned from studying Shreveport and Caddo Parish could apply to many other petroleum exporting communities.

### Literature/Historical Review:

The major factors thought to have caused Caddo Parish economic fluctuations between 1980 and 2013 include changing crude oil and natural gas prices, employment levels at the Western Electric and General Motors plants, riverboat casino operations, two major hurricanes, local film production spending, Haynesville Shale development, the global financial crisis, the Macondo Well blowout, and the offshore drilling moratorium. For purposes of this study, basic industries are defined as those Caddo Parish businesses that sell the vast majority of their goods and services to consumers outside of the parish. These basic industries are most important because they bring cash into the parish economy stimulating further cash circulation within the parish, the so called multiplier effect. As demonstrated in Wisinger 1989, the multiplier effect is effectively measured through changes in retail sales. Though in 2011 Caddo Parish produced agricultural revenue of \$130,584,232 with the leading commodities being cotton, cattle forestry and horticulture (Caddo Parish Farm Bureau 2013), in comparison to total yearly retail sales, agriculture income fluctuations are not thought to constitute a major source of parish retail sales instability. Shreveport is a regional medical center and while healthcare is the largest job providing economic sector (CityTownInfo.com 2013), this sector doesn't customarily rely on out of parish customers for its revenue stream.

However, two Shreveport manufacturers that meet the basic industry definition and thought to have measurable impacts on Caddo Parish retail sales prior to their closings are Western Electric (later AT&T Consumer Products) and General Motors. Built during the 1960's, the Western Electric Plant in Shreveport was one of only two facilities that produced telephones for the AT&T system and once built the majority of U.S. pay telephones (ArchAngle 2013). In 1982 alone, the Shreveport plant paid \$127 million for payroll (Dobson 1983). Because AT&T had required customers to only use AT&T equipment, the loss of AT&T monopoly status on 1 January 1984 caused the plant to fall on hard times (ArchAngle 2013; Gannett News Service 1989). While the plant started 1985 with nearly 7,400 employees, AT&T decided midyear to transfer production to Singapore, and so between July and November 1985, the plant cut over 3,100 employees (Markides and Berg 1988; Layoff ax lands again and again at AT&T plant 1985). Employment dropped to 3,300 by 1989 (Watson 1989), and in a post 9/11 national hangover, the Shreveport plant quietly closed during the first quarter of 2002 (Avaya, Inc. 2002).

Local officials hoped another manufacturing plant would help fill the void created by the decline of Western

Electric. Opening in October 1981 amid great fanfare, the General Motors Shreveport Assembly plant grew to become one of Louisiana biggest manufacturing employers. In the early days, 1,200 employees worked there building the small, energy efficient Chevrolet S trucks (Roy 2009). During 1982, employment rose to 1,600 with a payroll of nearly \$47 million (GM spells local bucks 1983). In 1983, GM Shreveport production switched to the Chevy S10 and in late July, GM added a second shift of 1,250 workers with another \$30 million in payroll (Roy 2009; Lamb 1983). Production continued on the S10 and the GM version, the GMC Sonoma, until 2003 when GM added the Chevy Colorado and GMC Canyon to the production mix to replace the smaller trucks. During April 2005, H3 Hummers started rolling off the assembly line replacing the midsize trucks. At its peak, total employment rose to over 3,200. However, with climbing gasoline prices and demand falling for the low gas mileage Hummer, the second shift was canceled late September 2008 and the plant closed August 2012 (Roy 2009; Roy 2012). Even after unemployment compensation mitigation, the huge changes in both Western Electric and General Motors payrolls should have impacted personal disposal income and therefore Caddo Parish consumer spending on retail sales in a major way.

In 1991, Louisiana passed legislation allowing 15 riverboat casinos statewide. In an attempt to mitigate manufacturing job losses and mimic the success that nearby Louisiana Downs horse racetrack had enjoyed since opening in 1974, Shreveport granted its first *legalized gaming* license allowing Harrah's of Shreveport (currently Sam's Town) to open a riverboat casino on the Red River in April 1994. Others quickly followed. The Isle of Capri-Bossier City (now DiamondJacks) opened May 1994 just across the river from Harrah's, and two months later, Horseshoe Casino Bossier City opened. Based on the success of the first three riverboat casinos, during October 1996 the Casino Magic (now Boomtown) opened in Bossier City (Arthur Anderson 1997), and in December 2000, Hollywood Casino Shreveport (now Eldorado Casino) also opened (International Guild of Hospitality & Restaurant Managers 2013). This riverboat casino was the second opened on the Shreveport side of the Red River. Most recently, on 15 June 2013 Margaritaville Resort Casino opened on the Bossier side (Hasten 2013). All six of the riverboat casinos are grouped relatively closed together near the downtown area of Shreveport.

To further entice tourists, large hotels were built adjacent to the riverboats with nice rooms, tasty food, bars, meeting rooms and some even have Vegas style shows and musical entertainment. With casino operator estimates of 60 to 80 percent of the customers arriving from East Texas and particularly Dallas, in 1995 alone, the three operating casinos recorded \$440 million in revenues. In 1996, the four operating casinos together employed 6,500. Because casinos pay above average wages, they forced local businesses to raise wages to keep their employees, and casinos employ above average numbers of women and minorities. Additionally, some gaming tax revenues are set aside for riverfront development on both sides of the river (Arthur Anderson 1997). Both the elevated payrolls and tourists spending should have led to major increases in Caddo Parish retail sales.

Although Shreveport was established as a river port, *The Shreveport Rose* (The Free Library 1994) casino was the first riverboat to dock at Shreveport in modern times. Moving riverboats to Shreveport back in 1994 presented navigational challenges because the Red River was not open for commercial traffic until 1 January 1995 (Red River Valley Association 2013). However while opening the Red River was an important economic development, compared to stimulants such as a riverboat casino, it is not thought the opening of the Red River to commercial navigation had a measurable impact on Caddo Parish retail sales.

On 23 August 2005 a tropical depression formed over the Bahamas, and by August 28<sup>th</sup>, the National Weather Service had warned residents that most of the U.S. Gulf Coast would be uninhabitable for weeks, and perhaps longer, after this strong hurricane struck. Because it is surrounded by the waters of Lake Pontchartrain and the Mississippi River and also lay directly in the projected hurricane path, particularly at risk was New Orleans. Stretching 400 miles in diameter, on the morning of 29 August 2005, Hurricane Katrina pummeled the Louisiana coast with sustained winds of between 100 and 140 miles per hour. After many hours of heavy rain, the levees failed seriously flooding nearly 80 percent of New Orleans. Adversely affecting 90,000 square miles of the Gulf Coast, Hurricane Katrina killed nearly 2,000 people and led to



hundreds of thousands fleeing evacuees (History 2013). This most costly hurricane in history destroyed over 100,000 homes (Hurricane-Facts.com 2013), displaced at least temporarily 135,000 Louisiana school students (CNN.com 2005), and changed New Orleans forever.

Less than a month later, on September 24th Hurricane Rita roared ashore the largely evacuated Louisiana Texas border region with top sustained winds of 120 miles per hours, knocking out power for over a million customers, sparking fires and swamping smaller Louisiana shoreline towns. Although Rita showed strength from Houston to New Orleans, 12 hours after coming ashore the weather service downgraded it to a tropical storm with top sustained winds of 50 mph as it drifted toward Shreveport. While another time Rita might have been considered devastating, coming in the immediate wake of Hurricane Katrina, residents sighed with relief that Rita was much less destructive than feared. Even damage to the concentration of coastal oil refineries appeared relatively light (Associated Press 2005). However, in the aftermath of these two hurricanes residents whose families had lived along the Louisiana coast and in New Orleans for generations fled the area never to return. Businesses also left the area. One of those was the film industry.

Back in 2002 the Louisiana Legislature introduced a head-turning motion picture industry development tax credit program to attract the estimated \$225,000 per day that major studios spend filming on location (FBT Film & Entertainment 2013). For those movie companies spending at least \$300,000 on production within Louisiana, state tax benefits included a transferable 30% tax credit for qualifying expenditures and a transferable 35% tax credit for payroll expenditures to Louisiana residents (North Louisiana Economic Partnership 2013). While this film industry legislation brought producers to New Orleans, Hurricane Katrina chased them away. Both Caddo Parish and the City of Shreveport went after these transient film producers. Working in partnership, the city and parish passed their own additional economic incentives in an eager effort to draw these displaced producers to the Shreveport area (Film Shreveport Bossier 2013a). In response, producers brought 134 movie/TV productions to northwest Louisiana, including 12 in 2005/2006, 23 in 2007, 23 in 2008, 18 in 2009, 15 in 2010, 18 in 2011, 16 in 2012, and 9 through June 2013 (Film Shreveport Bossier 2013b). Besides the obvious travel expenses, filming on location also involves paying local rent, suppliers, tradesmen, artists, workers, programmers, accountants, lawyers, and administrators. Collectively, these changing expenditures levels should have profoundly impacted Caddo Parish retail sales.

On 24 March 2008 Chesapeake Energy Corporation happily startled the residents of Caddo Parish by announcing a new commercially viable natural gas discovery within the Haynesville Shale of Louisiana (Chesapeake Energy Corporation 2008). According to the Louisiana Department of Natural Resources:

*The Haynesville formation is a layer of sedimentary rock more than 10,000 feet below the surface of the Earth in the area of northwestern Louisiana, southwestern Arkansas and eastern Texas, with some of the formation stretching well across the northern central portion of the Louisiana. Several energy companies have begun work in the area to explore the shale formation and drill for natural gas based on findings indicating a potentially large supply of gas trapped within some portions of the shale.*

*The formation is of a type once considered too costly to explore, but rising energy costs and newer technology and processes [horizontal drilling and hydraulic fracturing] have changed that, leading to a rush of activity as energy exploration companies have begun to lease property in north Louisiana in preparation for possible drilling and production. In light of that, the value landowners are able to get for selling leases has risen sharply (Department of Natural Resources 2013).*

Geologists have long known about the huge natural gas content of some highly porous yet nearly impermeable shale formations. However, commercial production requires that natural gas migrate to the drain hole to be recovered and shale gas does not freely move within these concrete like formations. However, the nontraditional technique of drilling horizontally within the horizontal length of a shale gas

reservoir dramatically increases the gas-bearing surface area exposed to the much longer perforated production tube, thus reducing the distance gas must travel to be recovered. Although highly controversial (Christopherson and Rightor 2012), using pressurized water to hydraulically fracture a shale formation dramatically stimulates gas migration and collection by the long horizontal drain hole. Combining horizontal drilling with hydraulic fracturing both improves natural gas migration and reduces the distance gas must migrate. While Haynesville Shale is highly geopressed leading to enhanced porosity and high gas content, this high pressure gradient also leads to high initial production rates followed by rapidly declining rates. According to Fred Wang and Ursula Hammes, “The decline rate in the first year can be as high as 80%,” (Wang and Hammes 2010).

Although Haynesville exploration began years earlier when a few companies started quietly accumulating acreage, after test results were publicly released, mineral leasing and drill rig activity increased exponentially (Halliburton 2013). By September 2009, Chesapeake Operating, Inc. had already completed two more horizontal Haynesville Shale wells in southern Caddo Parish (Exploration News Gulf States 2009). And by the end of 2010, the proven reserves of the Haynesville/Bossier Shale (Haynesville formation and Bossier formation are frequently referred to as a single formation) were already estimated to be nearly 24.5 billion cubic feet and growing (U.S. Energy Information Administration 2012). Covering parts of east Texas and northwest Louisiana, Haynesville/Bossier Shale could turn out to be the largest deposit of recoverable gas within continental U.S. with wildly optimistic estimates going as high as 250 trillion cubic feet in recoverable gas. In the months following public announcement, petroleum boom optimism revealed itself as upfront payment for mineral rights climbed from hundreds of dollars per acre to 30 thousand dollars per acre in some cases (Nossiter 2008) causing natural gas producers to highly leverage their leasehold purchases. For example, the State of Louisiana sold seven leases in Caddo Parish for more than \$30,000 per acre in bonus plus 30% royalty (State Mineral and Energy Board 2008). “Without question, there’s money flowing in already,” said the mayor of Shreveport, Cedric Glover. “The energy in the area, you can sense it; you can feel it” (Nossiter 2008). But how long will it last, the Louisiana Haynesville Shale rig count has already gone down from the drilling frenzy high of nearly 140 in 2010 to below 20 in 2012 (Hutchinson 2012). Still, Haynesville Shale money clearly increased consumer spending in Caddo Parish in a major way.

The beginning of the financial crisis of 2007-08 is difficult to pinpoint exactly. Perhaps the best starting date is 29 September 2008 only months after the Haynesville Shale announcement. On that day, the Dow Jones Industrial Average fell 778 points losing nearly 7% of its value or \$1.2 trillion market value in reaction to Congressional rejection of the \$700 billion bank bailout plan (Twin 2008). Within the U.S., banks collapsed, the credit markets froze, new investment ceased, real estate prices plunged, consumer spending dropped, foreclosures skyrocketed, business failed, and unemployment rose to exceptionally high levels. The economic havoc was contagious. Declines in U.S. consumer spending hurt both China and the oil exporting countries as oil prices plunged. In Europe, growing bad loan losses resulted in undercapitalized banks. That plus member countries incurring unsustainable sovereign debt characterized the *Eurozone Crisis*. As a result of the growing crisis, European demand for natural gas fell, hurting the Russian economy. Even the Japanese economy and the Pacific Tigers were not spared the loss of demand for their industrial exports as the crisis continued to spread globally. But coming on the heels of the Haynesville Shale announcement, this global crisis is not thought to have measurability impacted Caddo Parish retail sales.

At 8:02 PM 50 miles offshore, the crew began pumping water-based spacer mud through the stinger to finish flushing the hole of drill mud debris and displace the synthetic oil-base mud in the riser. Although unnoticed, by 9:05 PM more mud flowed out of the well hole than the amount of seawater being pumped into the hole. But the inflows and outflows should have been equal. Eventually somebody noticed something was wrong because at 9:30 PM, pumping into the hole abruptly stopped and 17 minutes later the tool pusher apparently tried to shut in the Macondo Prospect well. But this did not stop pressurized crude from gushing toward the drilling platform. At 9:49 PM on 20 April 2010 this spewing crude ignited and the *Deepwater Horizon* exploded into flames leading to the death of 11 brave workers and injuring many others (Parsons 2010).

Shrinking global oil reserves and spiking oil prices have pushed companies to attempt drilling in higher risk environments. In this case, the resulting economic and ecological damage is nearly impossible to measure. For 87 days the Macondo oil well deep underwater offshore Louisiana leaked between 35,000 and 60,000 barrels per day with a total estimated release of 4.9 million barrels (McNutt et al 2011), which makes it the second worst in history only behind the Kuwait 11.5 million barrel Gulf War spill in 1991. By comparison, the Exxon Valdez in 1989 spilled less than 250,000 barrels. Forty-seven percent of the Louisiana population lives in coastal areas. Prior to Macondo, the Louisiana coastal region supported 27,000 fishing jobs responsible for 21 percent by weight of all fish caught in the lower 48 states (The Rundown 2010). Besides commercial fishing, the spill also directly impacted vital tourism dollars. It also led to the Gulf of Mexico drilling moratorium.

On 30 April 2010, President Obama announced a moratorium on offshore leasing (Johnston and Nichols 2010). In response the American Petroleum Institute commissioned an angry report claiming the moratorium combined with changes to the permitting process would result in over \$24 billion lost U.S. investment and that during 2010 the moratorium had already reduced U.S. employment by 72,000 jobs (Bertrand 2012). The State of Louisiana released a report stating that more than 20,000 Louisiana jobs were at risk because one in three Louisiana jobs is related to the oil & gas industry and the six month drilling moratorium would cripple the state economy (emergency.Louisiana.gov. 2010). In October 2010, the federal government officially lifted the moratorium (Jackson 2010). However, the highly controversial administration policy of slow walking drilling permits constitutes a continuing *de facto* moratorium on drilling offshore Louisiana (Marzulla 2013). The economic ripples of the Macondo accident/moratorium very possibly impacted Caddo Parish retail sales by a measurable amount.

A model must be specified to measure economic impacts. For model specification, the authors of "The Economic Impact of the Natural Gas Industry in La Plata County, 2003-2004," performed economic input output (IO) analysis using multipliers for the Southwest Colorado Region obtained from the U.S. Bureau of Economic Analysis to estimate the natural gas impacts on output in La Plata County (Walker and Sonora 2005). Also used in the *Economic Impact of the Haynesville Shale on the Louisiana Economy* (Dr. Loren C. Scott & Associates, 2010), this IO approach is typical of economic research assessing local impacts of specific industries, but suffers from the problem of assuming a multiplier rate rather than actually measuring it. Nigeria, the largest oil producer in Africa and the sixth largest in the Organization of Petroleum Exporting countries, is a major oil exporting country with 82% of its tax revenue derived from the petroleum industry. In attempting to measure the positive impact of rising oil prices on Nigerian Gross Domestic Product (GDP) from 1970 to 2009, Ogbonna and Ebimobowe used linear regression analysis (Ogbonna and Ebimobowe 2012). Importing over half of its yearly consumption of oil, the U.S. is a major oil importing country. In attempting to measure the negative impact of higher oil prices on U.S. GDP growth rates between 1960 and 2009, Farhani also used linear regression. However, to reduce possible problems with heteroscedasticity (the systematic relationship between the size of the error and size of an independent variable), the author performed linear regressions on the natural logarithms of both oil prices and GDP growth (Farhani 2012). However, a weakness of the log model is that model results are more difficult to interpret and therefore should not be used unnecessarily. In summary, recent peer reviewed academic literature reveals that linear regression can be used when trying to measure the multiplier impacts of oil prices on both oil exporting regions and oil importing regions.

### Econometric Model and Data:

Like GDP, retail sales volume is a commonly accepted indicator of economic health. Based on the literature/historical review, major factors causing Caddo Parish monthly retail sales to vary during the 33 year period ending December 2012 would seem to include inflation, yearly seasonality, changing crude oil and natural gas prices, employment levels at Western Electric and General Motors, the number of operating riverboat casinos, the two hurricanes and resulting film producer behavior, the financial crisis, the

Haynesville Shale announcement, the Macondo Well blowout and the ensuing drilling moratorium. With appropriate data, an econometric model could be specified to measure the relationship between these independent variables and the dependent variable of monthly retail sales. According to the literature, regression analysis is an accepted tool for measuring correlations and building econometric models. Wisinger 1989 used only simple regression analysis to model the Caddo Parish economy. This study advances to multivariate regression analysis.

Data comes from a variety of sources. The Caddo Shreveport Sales and Use Tax Commission supplies the information needed to calculate taxable Caddo Parish monthly retail sales (Caddo-Shreveport Sales and Use Tax Commission 2013). Each month's sales are determined by dividing the following month's tax collections by the sales tax rate. Inflation is adjusted for using the Consumer Price Index (CPI) (Bureau of Labor Statistics 2013). Produced in the Permian region, West Texas Intermediate (WTI) is a low-sulfur crude with an American Petroleum Institute (API) gravity of 40. WTI Cushing is the current benchmark for U.S. crude oil prices on the New York Mercantile Exchange (NYMEX) because Cushing, Oklahoma is one of the world's biggest storage/transportation hubs (Wertz 2012). While the U.S. Energy Information Administration (EIA) provides the monthly average Cushing, OK WTI FOB spot (i.e. settlement) prices for this study, the EIA records only go back to January 1986 (U.S. Energy Information Administration 2013a). But WTI Midland TX and WTI Cushing OK usually trade very close to the same price (MT Newswires 2013) and the International Monetary Fund (IMF) has WTI 40API Midland prices going back to January 1980. So, the IMF provides the WTI oil prices for the period between January 1980 and December 1985 (International Monetary Fund 2013a). Monthly crude oil in May 2013 dollars per barrel are shown in Figure 1.

The natural gas spot price currently used by the NYMEX is the Henry Hub price because the largest centralized point for natural gas spot prices in the U.S. is Henry Hub. The Henry Hub in Erath, Louisiana interconnects with four intrastate pipelines and nine interstate pipelines accessing much of the U.S. The Henry Hub quotes the average price from these 13 interconnected pipelines (Henry Hub 2013a; Henry Hub 2013b). While the IMF provides the Henry Hub monthly prices for this study, the IMF records only go back to January 1991 (International Monetary Fund 2013b). However, the EIA provides U.S. natural gas wellhead monthly prices between January 1980 and December 1990 (U.S. Energy Information Administration 2013b). But there are two problems with the natural gas data that must be addressed. First is that wellhead prices are measured in dollars per thousand cubic feet (Mcf) and must be converted to dollars per million British Thermal Units (MMBtu) by dividing the \$/Mcf prices by 1.023 to equal \$/MMBtu prices (U.S. Energy Information Administration 2013c). Second is that Henry Hub prices are measured downstream of wellhead prices and thus are not the same. However according to the EIA, wellhead prices and Henry Hub prices correlate nicely, with Henry Hub prices averaging 10.8% higher (Budzik 2013). Thus, the wellhead prices are increased accordingly to approximate Henry Hub where necessary. Monthly natural gas prices in May 2013 dollars per MMBtu are shown in Figure 2.

Monthly retail sales, monthly oil prices, monthly gas prices all cover the period from January 1980 through December 2013, and using the CPI, all are adjusted for inflation to equal May 2013 dollars. This adjustment reflects that a January 1980 dollar had nearly three times as much purchasing power as a May 2013 dollar. After the inflation adjustment, to eliminate seasonal variation, sales are adjusted based on 12 monthly indexes. Each of these 12 indexes is derived from the ratio of each of the month's grouped sales to the grand sales total for the 33-year period. These resulting 12 indexes are then multiplied times the corresponding month's sales to remove seasonal variations in retail sales such as the Christmas shopping effect in December. Seasonally adjusted monthly Caddo Parish retail sales in May 2013 dollars are shown in Figure 3. Thus adjusted, all the monetary amounts are ready for data entry into the regression model.

As shown in Table 1, Film Shreveport Bossier supplies yearly film budget totals (Film Shreveport Bossier 2013c). Unfortunately, exact dates and expenditure amounts are unavailable so each year's budget total is first divided by 12 to approximate each month. To smooth out the transition between years, each month's



figure is further refined to be a running 12-month average of the prior four months and subsequent seven months figures while making pro rata adjustments to insure the integrity of calendar totals is maintained. Estimated monthly budgets in millions of dollars for 2005 are \$16.75, for 2006 are \$19.42, for 2007 are \$15.17, for 2008 are \$21.5, for 2009 are \$8.19, for 2010 are \$15.17, for 2011 are \$6.41, and for 2012 are \$6.7.

Wisinger 1989 successfully modeled Caddo Parish retail sales using only a linear specification so based on the data deemed causal from the literature/historical review, the linear regression model assumes the following form:

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \beta_8 X_{8i} + \epsilon_i \quad (1)$$

where Y is Caddo Parish monthly retail sales as adjusted for seasonal variation and inflation, i represents the individual month,

X<sub>1</sub> is average monthly WTI oil price as adjusted for inflation,

X<sub>2</sub> is average monthly Henry Hub gas price as adjusted for inflation,

X<sub>3</sub> is a dummy variable representing the massive Western Electric layoffs starting July 1985,

X<sub>4</sub> is number of shifts working at GM plant for any given month,

X<sub>5</sub> is number of operating riverboat casinos for any given month,

X<sub>6</sub> is monthly estimated film budget in millions of dollars for any given month,

X<sub>7</sub> is a dummy variable representing the beginnings of Haynesville Shale starting October 2008,

X<sub>8</sub> is a dummy variable representing offshore drilling moratorium starting April 2010,

α is the regression constant,

β<sub>n</sub> represent the corresponding regression coefficients, and

ε is the error term.

Having occurred so close in time together, the economic impact of Hurricanes Katrina and Rita on Caddo Parish cannot be initially separated from the beginning film industry expenditures with the available data; therefore, the hurricanes are omitted. Likewise, the same is true with the overlapping of the financial crisis and the discovery of Haynesville Shale; accordingly, the financial crisis is also omitted from model specification.

### Findings and Conclusions:

The goal is to produce statistical models that track the evolution of Caddo Parish dependency on oil and gas. For the period beginning January 1980 and ending December 2012, retail sales averaged \$383.2 million per month with a standard deviation of \$46.56 million per month in May 2013 dollars. Oil prices averaged \$54.68 per barrel with a standard deviation of \$27.45, and natural gas averaged \$4.96 per MMBtu with a standard deviation of \$2.26 after adjusting for inflation. Starting with the 10 year period ended December 1989; the first linear regression covers 10 years, i.e. 120 periods.

The next regression covers the 10-year period ending December 1990 and so on, *mutatis mutandis*, through the 10 year period ended December 2012. This procedure produces 24 overlapping time lapse regression models. Time lapse modeling methodology maximizes data utilization for dynamic beta coefficient trend identification. Using the stepwise method, ordinary least square (OLS) regressions are run on SPSS software, version 20. The results are shown on Table 2.

Regression analysis measures and correlates system shocks and one of the best places to start when evaluating regression results is to look at the  $R^2$  (also called the Coefficient of Determination), which measures “goodness of fit.” The first five and the last three regressions produce  $R^2$  coefficients above 0.5, however, 16 do not. In other words, eight of the models correlate more than half the changes in monthly retail sales with changes in the supposed causal variables while 16 correlated less and in one case as little 8.4%. Still, all 24 of the regressions produce statistically significant correlation coefficients at the 95% confidence level and offer economic insight.  $R^2$ 's reflect model explanatory power. For example, the regression model covering the 10 years ending December 1992 has an  $R^2$  of 0.603. This means that just three independent variables: 1) changes in natural gas prices, 2) the massive Western employee layoffs starting back in 1985, and 3) the addition of a second shift at GM explain over 60% of the dependent variable (retail sales) monthly fluctuations. However, the regression model for the 10 years ended December 2004 struggles to find significant correlations with just the independent variables specified. There are two possible explanations for this outcome. One is the model omits one or more important independent variables. Two, with the exception of riverboat casinos, there were no major players with changes impacting retail sales, but instead only lots of little ones that would be impossible to parsimoniously model. This specification problem could be indicative of growing diversity among smaller employers and/or activities within the non basic business sector. Regardless of cause, a low  $R^2$  creates concerns about too much weight being accorded the specified independent variables; thus, the higher the  $R^2$ , the more credible is the estimated beta coefficient. And while not thought to materially impact the accuracy of statistically measured independent variables during these periods, with the exception of the 2001 model, specification shortcomings are particularly noticeable for the models between 1994 and 2007. However, the Durbin Watson Statistic indicates no autocorrelation problems in model specification that could bias results and residuals appear normally distributed.

While correlation can never prove causation, a mechanistic explanation of causation can be supported by correlation analysis. Thus, the statistical evidence indicates for the 10 year periods ending in 1989 and 1990, more than half the changes in Caddo Parish retail sales are explainable by changes in the prices of natural gas and oil. Reflecting the impact of plunging oil prices during the 1980s, for the ten years ending December 1989, statistically speaking, a dollar decrease in average price of a barrel of oil matched a \$451,417 decrease in monthly retail sales (the 95% confidence range is \$25,453 to \$877,381 with \$451,417 being the mean). For the ten years ending December 1990, a dollar decrease in the natural gas price of a million Btu's, matched a \$17,408,139 decrease in retail sales (the 95% confidence range is \$11,070,913 to \$23,745,365).

Selling locally produced oil and natural gas on the national market provides Caddo Parish with tremendous cash inflow. In January 1980 Caddo Parish produced 286,442 barrels of crude. By January 1994, this had fallen to 239,878 barrels. During January 2003 Caddo Parish produced 152,332 barrels of oil and December 2013 production was 153,820. Production for the 10 year period ending December 2012 varied little from the 10 year average of 147,057 barrels (SONRIS 2013). Like an oil exporting nation, the degree of Caddo Parish dependency on the oil industry can be measured by the positive impact that oil price increases have on retail sales. Reflecting the decline in crude production, however, never after 1990 does a 10 year regression show a positive impact on retail sales resulting from rising oil prices? In fact, by December 1997, in a complete reversal, the 10 year regression shows that an increase in oil prices actually had a negative impact on retail sales. Compelling evidence of the evolving relationship between Caddo Parish and the oil industry is demonstrated by model results showing that starting with the 1997 model period, increases in oil prices actually hurt Caddo Parish retail sales. Like oil importing nation, as oil prices raised Caddo residents

spent more for imported gasoline and consumer products reducing local purchasing power and hurting the Caddo Parish economy. Currently, the opposing positive and negative impacts of oil price changes appear to be near equilibrium in Caddo Parish. Without major changes in area oil production, the statistically insignificant impact of oil prices changes on current retail sales should remain unchanged.

Increases in natural gas prices positively impact Caddo Parish up through the 10 year period ending December 1996 and again on the 10 year regressions ending December 2001, December 2002, and December 2005. Reflecting decreasing traditional natural gas production, however, even the positive impact of rising natural gas prices hugely decreased starting with the model period ending in 1994. Model results reveal a decreasing dependence on natural gas prices with no statistically significant impact of natural gas prices changes on Caddo Parish retail sales since the 2005 period model.

One of the pitfalls of regression model specification is multicollinearity, i.e. two or more independent variables correlating too closely. Inclusion of both oil prices and natural gas prices might present such a problem, but omitting one could result in too much authority being accorded the other. For example, the 1989 Wisinger paper observed a correlation of \$1.3 million between a dollar change in a barrel of oil and monthly retail sales. Since natural gas was omitted from that model, that \$1.3 million in 1988 dollars undoubtedly captures at least some of the impact of changing natural gas prices, too. However, because oil and natural gas prices do not march lockstep with each other, both values can be teased out simultaneously. The typical 42 U.S. gallon barrel of oil contains 5.8 times more energy than a natural gas MMBtu (Office of Chief Counsel 2010). Thus, a barrel of oil should sell for 5.8 times more than a comparable MMBtu of natural gas. However, the ratio varies according to the supply and demand for each source of energy as shown on Figure 4. Because of the glut of natural gas caused by the discovery of shale gas (Ridley 2011), currently oil energy is much more highly valued than natural gas energy with the average ratio for 2012 being 34 to 1. Caddo Parish depends on the newly discovered shale natural gas, but currently sellers of natural gas are only receiving about 1/6 of the price of a comparable amount of oil. However, as the global economies adapt to consuming higher volumes of natural gas, the price ratio will move back toward one barrel of oil equaling 5.8 MMBtu's of natural gas.

As expected, manufacturing slowdowns and layoffs at the Western Electric plant correlate with a dramatic decrease in Caddo Parish retail sales. The regression model for the 10 years ending December 1991 reflects a statistically significant monthly drop in retail sales of \$24,515,720. Similar staggering sums show also on the models for the periods ending December 1992, 1993 and 1994 with 1993 being over \$30 million. Likewise, according to the regression models, the 1983 addition of a second shift of workers at the GM plant shows a positive impact of \$30 million per month and its final shutdown in 2012 shows a nearly \$18 million per month negative impact. The drop in oil and gas prices and the layoffs of Western Electric delivered serious body blows to the Caddo Parish economy during the 1980s. As a result, according to the regression analyses, the composition of the Caddo Parish economy changed significantly between 1980 and 2012. The 1989, 1990, 1991, 1992, 1993, 2010, 2011 and 2012 models all have an  $R^2$  above 0.5. As revealed by these models, the major volatile players impacting retail sales in 1989 and 1990 are oil and gas prices, whereas the major recurring volatile players impacting retail sales in 2011 and 2012 are the film industry and Haynesville Shale. The Macondo accident led drilling moratorium produced no measurable impact.

The entertainment sector reflects statistically significant correlations with Caddo Parish retail sales starting with 1994 when the first riverboat casino opened. According to the regression models, when measurable, each of the five boats adds between \$4 million and nearly \$14 million to Caddo Parish sales each month. Based on a regression of the entire 33 year period, this study expects the new riverboat that opened in June 2013 to raise Caddo Parish retail sales by between \$3.5 and \$7 million per month. Ever since Hurricane Katrina, film industry expenditures have substantially impacted Caddo Parish retail sales. Each film industry monthly dollar budgeted for expenditure positively correlates with between a \$2.2 (2007) and a \$2.99 (2006) increase in monthly retail sales although these figures are possibly contaminated by hurricane aftermath.

For the last three years, however, the average monthly increase in Caddo Parish retail sales attributable to local film activities is \$24.6 million per month. So how stable is the northwest Louisiana relationship with the heavily tax subsidized film industry? With so much interstate competition for film industry dollars (Luther 2010), the growing Louisiana film industry tax credit controversy (Mathis 2012), and south Louisiana recovering from two vicious hurricanes, northwest Louisiana will be fortunate to keep these major dollars flowing.

Lastly is the announcement of the viability of nontraditional Haynesville Shale natural gas production and the mineral leasing and drilling frenzying it unleashed beginning in 2008. While it is a virtual certainty the global financial crisis negatively impacted many individuals and business within Caddo Parish, the positive impact of Haynesville Shale makes that impossible to measure with this model. Each month since the Haynesville announcement, accordingly to the 10 year models, an increase of between \$47 and \$67 million per month was added to Caddo Parish retail sales. An overall review of the model summary shows that overwhelming dependence on oil has ended and that natural gas dependency has seemly changed from traditional drilling expenditures and varying royalties payments to horizontal drilling and Haynesville/Bossier Shale mineral leasing, at least temporarily. During the month of January 2003, Caddo Parish gas wells produced nearly 1.6 million Mcfs. And despite low natural gas prices, by December 2012 monthly gas production had grown to nearly 18.6 million Mcfs although this was down from the July 2011 peak of 26.4 million Mcfs (SONRIS 2013). It is the race to develop Haynesville Shale rather than the current price of natural gas that is driving the positive impact on retail sales recently. This conclusion is based on the observation that changes in natural gas prices after 2005 no longer statistically correlate with changes in Caddo Parish retail sales while activities following the 2008 announcement of Haynesville Shale reflect a very significant positive correlation with retail sales. Perhaps the impact of future natural gas prices changes will again be measurable as natural gas finds new markets, the glut eases, and prices inevitably rise (Bonanza or Bane 2013). The 2012 average price per MMBtu for gas was \$2.79. However, 2008 data from Barnett Shale production reveal that at least \$4, and often much more, is required just to cover cost (Rogers 2011). Currently natural gas producers are conflicted by their need to exploit Haynesville Shale rather quickly to fund their highly leveraged, and highly publicized mineral right purchases and their desire to delay production until natural gas prices again approach the energy equivalency price ratio of 5.8 MMBtu's for every crude oil barrel (Chesapeake to Sell Assets in Eagle Ford, Haynesville Shales to EXCO for \$1 Bln 2013).

During the 1980s, based on model results oil accounted for \$27.88 million and natural gas accounted for \$81.62 million in monthly retail sales. So for the 1980s, together local oil and gas activities contributed \$109.5 million per month to Caddo Parish retail sales. By comparison, Haynesville Shale natural gas currently only accounts for \$58.58 million per month or just over 50% of the impact of oil and gas collectively during the 1980s. Furthermore, the current impact of Haynesville Shale gas is less than the solo impact of 1980s natural gas sales. Clearly, dependency on oil and gas prices has diminished in Caddo Parish. There is a tremendous amount of natural gas lying in the Haynesville Shale, so no doubt gas will be a major player for some time. But like the riverboats and the film industry, much of the profits are directed to out-of-town operators. Haynesville Shale gas should continue to generate sizable cash flow, although, without dramatic price increases, perhaps at decreasing amounts over time.

After adjusting for inflation, per capita retail spending in Caddo Parish shows a very modest increase from \$19,067 in 1980 to \$19,131 in 2012. However, considering the economic declines of 2012 and 2013, the question remains: Has the Caddo Parish economy evolved for better or worse? Much of the downtown Shreveport skyline was built during the oil boom years of the early 1980s, but with the growth of the medical sector and less dependence on a few major manufacturing and oil & gas employers, the Caddo Parish economy has evolved to be more diverse (even though this diversity includes the uncertainty of continued Hollywood local film spending) and therefore seemingly more stable than it was in 1980. Still, this newfound diversity did not protect the metropolitan area from recent economic setbacks. And, while



broadening the Caddo Parish economic base lowered its susceptibility to oil & gas industry ups and downs, it did so by increasing economic ownership outside of local control; thus, there are no recognizable entrepreneurial growth opportunities like when United Gas and Texas Eastern were born in northwest Louisiana.

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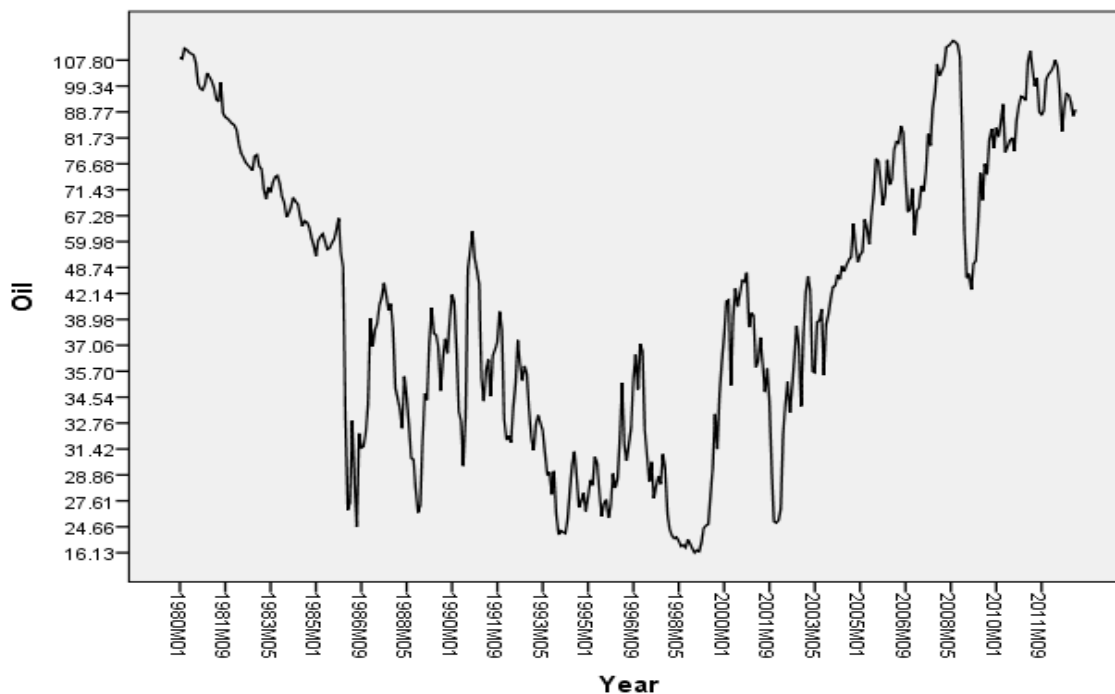


Fig. 1 West Texas Intermediate Oil Price per Barrel as Adjusted

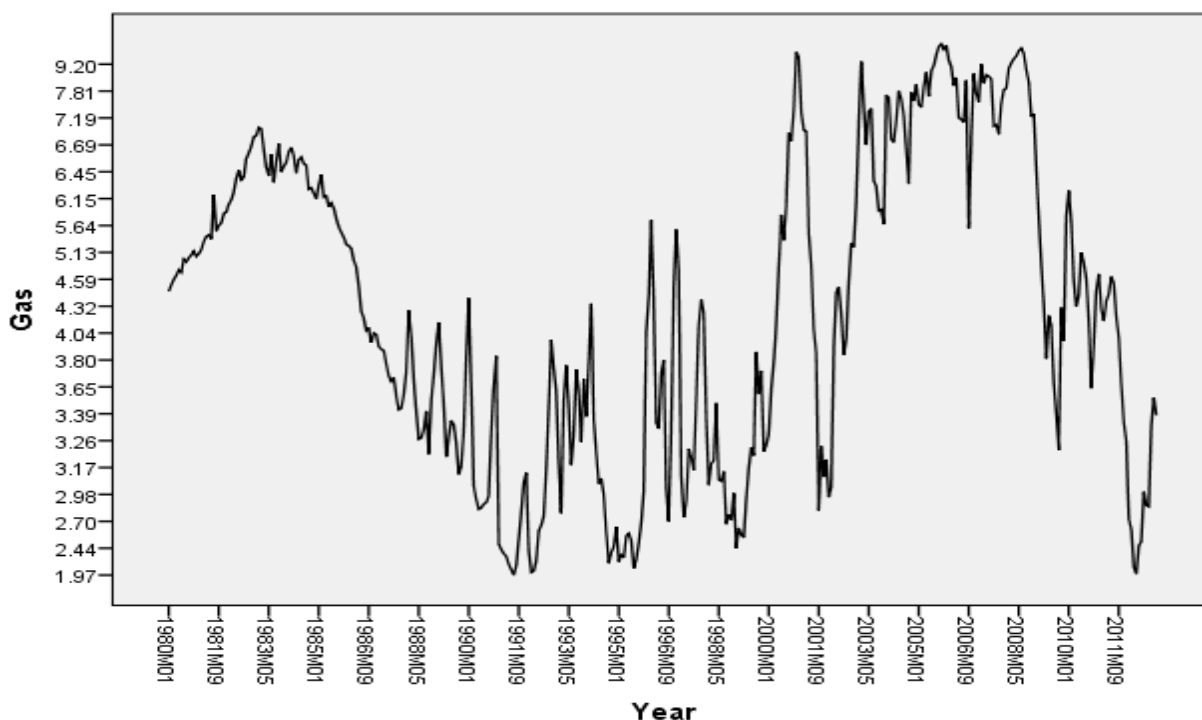


Fig.2 Henry Hub Natural Gas Price per MMBtu as Adjusted

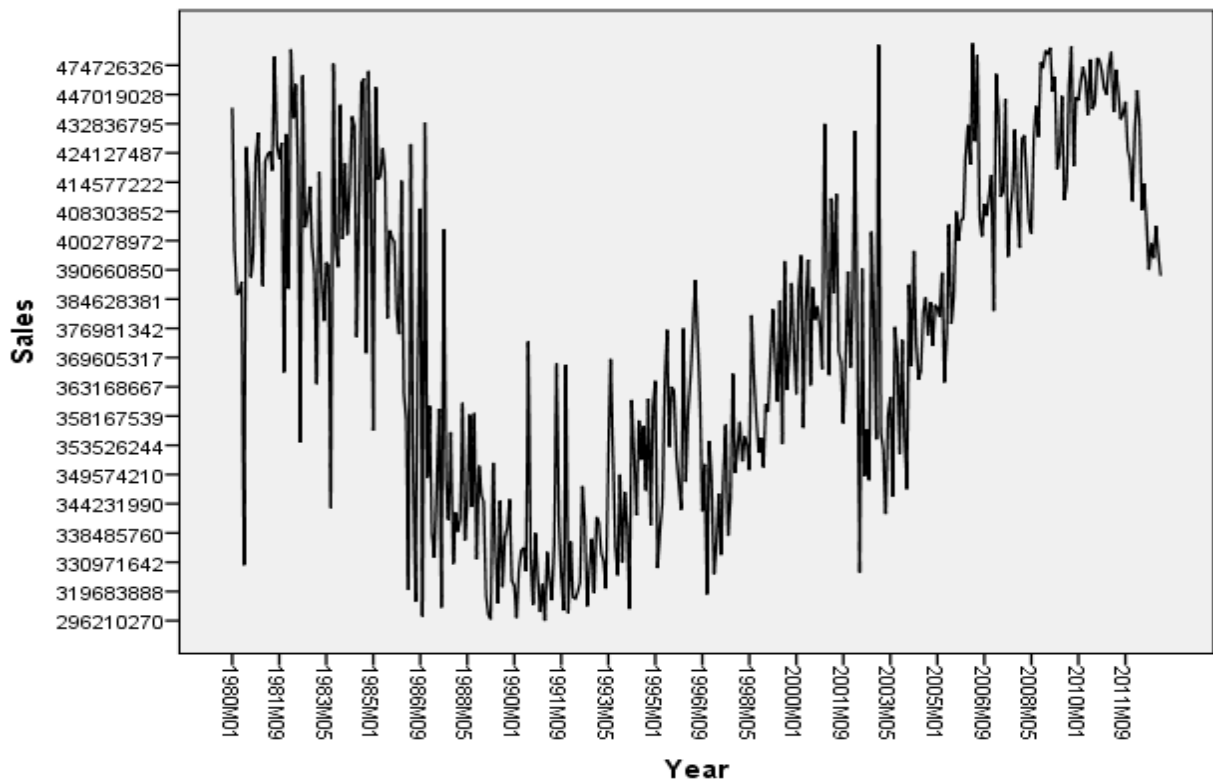


Fig. 3 Caddo Parish Retail Sales as Adjusted

Table 1 Film Production Totals for Northwest Louisiana				
Year	Movie/TV Productions	Production Days	Budgets (in \$Million)	Hotel/ Motel Rooms
2005/2006	12		300	
2007	23	557	182	
2008	23	539	258	31,758
2009	18	277	98	14,763
2010	15	473	182	30,677
2011	18	679	77	13,692
2012	16	240	80	12,242
2013 (Thru June)	9	115	7	2,911



Table 2 Stepwise Regression Summary of Statistical Significance (95% confidence level), i.e. Monthly Impact on Caddo Parish Retail Sales

10 Years Ended	Constant	\$ Change in Oil Price per Barrel	\$ Change in Gas Price per MMBtu	Western Electric Layoffs	Value of GM Shift of Workers	Value Per Riverboat	Value Per \$Million Film Budget	Haynesville Shale Activity	R <sup>2</sup>	Durbin-Watson Statistic
Dec-89	279,299,588	451,417	16,003,718	(8,285,211)	0	0	0	0	0.5300	2.201
Dec-90	256,805,896	631,657	17,408,139	0	0	0	0	0	0.5740	2.123
Dec-91	311,934,456	0	15,678,275	(24,515,720)	0	0	0	0	0.5750	2.174
Dec-92	248,900,312	0	16,536,454	(26,316,303)	30,604,212	0	0	0	0.6030	2.372
Dec-93	315,730,304	0	16,101,521	(30,350,389)	0	0	0	0	0.5890	2.233
Dec-94	316,312,499	0	15,650,658	(29,633,861)	0	8,457,448	0	0	0.4100	2.139
Dec-95	304,785,261	0	10,074,985	0	0	7,342,604	0	0	0.1130	2.126
Dec-96	335,536,875	0	6,308,701	0	0	0	0	0	0.1890	1.774
Dec-97	358,897,953	(713,358)	0	0	0	4,266,883	0	0	0.2570	1.712
Dec-98	351,571,481	(555,338)	0	0	0	4,821,304	0	0	0.3360	1.730
Dec-99	349,325,131	(478,831)	0	0	0	5,736,780	0	0	0.3820	1.638
Dec-00	333,386,544	0	0	0	0	7,286,288	0	0	0.3780	1.470
Dec-01	321,993,993	0	4,068,555	0	0	6,779,049	0	0	0.4590	1.558
Dec-02	321,238,972	0	4,853,461	0	0	6,654,481	0	0	0.2700	1.529
Dec-03	331,558,600	0	0	0	0	8,317,841	0	0	0.1110	1.837
Dec-04	324,689,590	0	0	0	0	10,054,051	0	0	0.0840	1.839
Dec-05	352,898,308	0	3,355,569	0	0	0	0	0	0.1250	1.852
Dec-06	307,737,013	0	0	0	0	13,829,351	2,994,191	0	0.3500	2.026
Dec-07	374,059,326	0	0	0	0	0	2,231,135	0	0.3420	2.072
Dec-08	377,218,143	0	0	0	0	0	2,554,968	67,806,641	0.4270	2.099
Dec-09	377,640,003	0	0	0	0	0	2,582,420	51,136,133	0.4600	2.051
Dec-10	378,123,478	0	0	0	0	0	2,516,587	47,312,583	0.5020	1.992
Dec-11	376,516,640	0	0	0	0	0	2,580,725	49,551,793	0.5100	1.980
Dec-12	336,195,276	0	0	0	17,847,019	0	2,870,421	58,576,199	0.5450	1.725

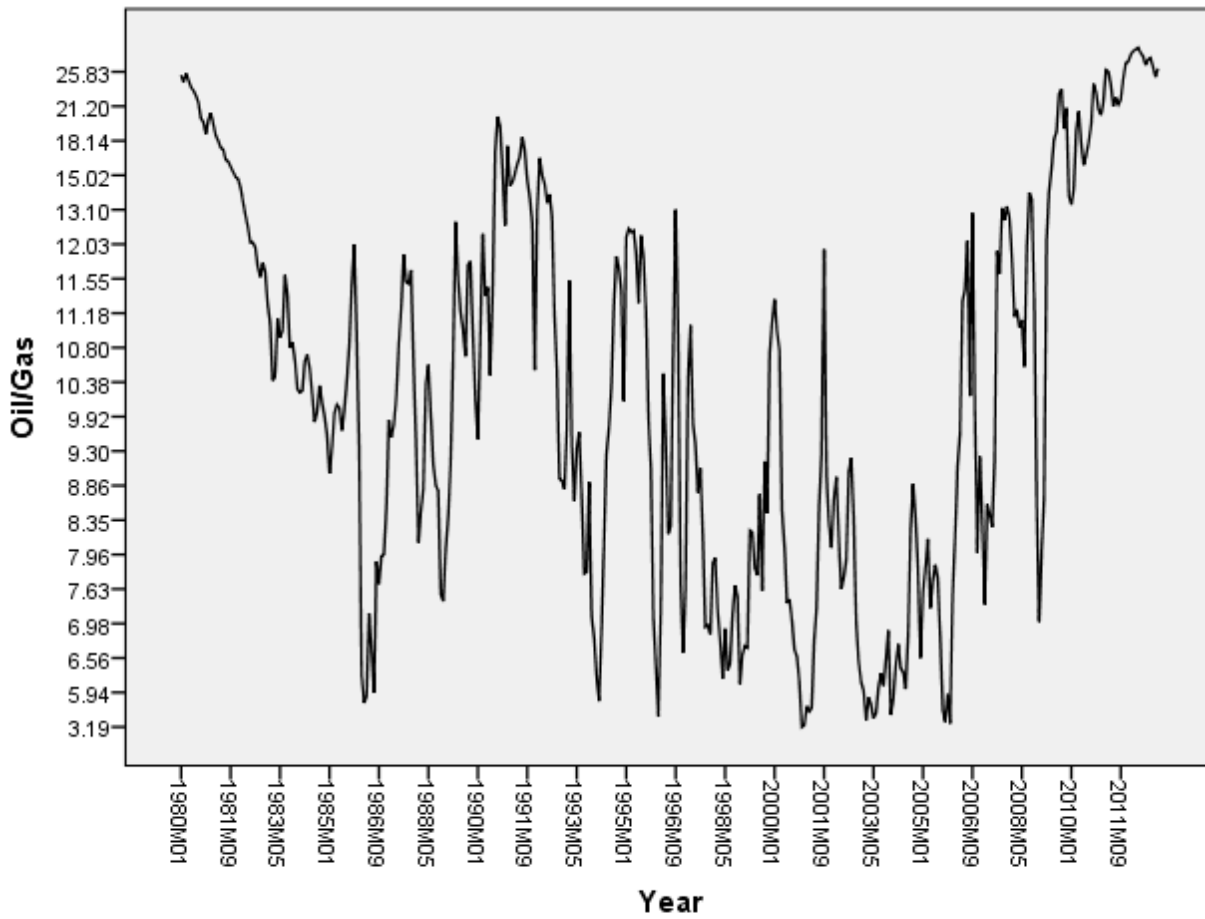


Fig. 4 Oil to Natural Gas Price Ratio